this matter, aſſured me it was fact, relying on the authenticity of their forefathers' relations. Further reports reſpecting this animal have *in part* ſlipped my memory, wherefore I omit making any mention of the ſame.

The panther is not conſidered by the Indians as *ſuch* a ravenous animal, as by the white people he is reported to be. I know but of one inſtance, where an Indian was nigh being attacked by one of them, but this was owing to the Indian's approaching his den. The Indian however found means of killing him, and taking the young, which he brought down to Philadelphia, which was about the year 1770. This animal, the Indians ſay, lives chiefly on deer, which it either by ſlyneſs catches itſelf, purſues after they have been crippled by the hunters, or takes from the wolves after they have caught them.

If hereafter, I ſhall have an opportunity of getting further information reſpecting the naked bear; I will freely communicate the ſame to you.

Believe me to be, Dear Sir,
Your truly affectionate friend, &c.
JOHN HECKEWELDER.

No. XXXII.

Experiments and Obſervations on Land and Sea Air. By ADAM SEYBERT, M. D.

Read March 10, 1797. AN endeavour to add any facts or obſervations to a branch of knowledge, which has been treated of by many of the moſt enlightened philoſophers of the preſent century, may be deemed a hazardous attempt. But although we have many accounts of eudiometrical experiments by Prieſtley, Fontana, Ingenhouſz

houſz and others; the ſubject is not exhauſted, and an extenſive field continues open for him who wiſhes to engage in this intricate branch of Pneumatic Philoſophy.

The purity of the air is not intereſting to us merely as an object of curioſity, but demands our attention as phyſicians and philoſophers. In proportion to the number of aſcertained facts, the certainty of inference is increaſed. The ſhort life of any one individual, together with his local ſituation, will prevent him from completing this department of ſcience. It is merely from repeated experiments made under different circumſtances, that we can expect to arrive at truth. The more we multiply facts the more decided may we be in our concluſions. Such are the reflections, which induced me to engage in a ſeries of experiments, which ſhall be related in the following pages.

Our atmoſphere having been ſo ſucceſsfully analyzed by the celebrated Lavoiſier, and being found to conſiſt of fluids poſſeſſing very different and oppoſite qualities; chemiſts ſoon began to enquire whether its ingredients might not be in various proportions in different ſituations; and, particularly, whether it differed in point of purity in different ſituations on land and on the ocean.

Moſt of the experiments of which we have an account were made on land: The Memoir of Dr. Ingenhouſz publiſhed in the 70th volume of the Philoſophical Tranſactions is the only eſſay I have ſeen containing experiments made at ſea: but his traverſe was ſo ſhort, that he had not an opportunity of examining the air in different latitudes. He, however is of opinion that ſea air is, cæteris paribus, purer than land air; but he appears to have found ſome ſeeming contradictions of his general inference. He ſays, page 364, that air taken from the middle of the channel was of an inferior quality to that at the mouth of the Thames; and that air near the

ſea ſhore at Oſtend was nearly as good as that at the mouth of that river. Although we may, to a great degree, adopt his ſentiments, nevertheleſs I think it probable that this increaſed purity does not entirely depend upon the ocean; for I have found the air over the Bays of Cheſapeak and Delaware of the ſame degree of purity with the atmoſphere of the ocean. And hence I am inclined to think, that the air over a large body of water is always purer, cæteris paribus, than that of the adjoining land, owing perhaps to a decompoſition, which the water may ſuffer from the action of the Sun's rays; and this may likewiſe be aſſiſted by its alſo abſorbing many foreign matters which on land are more or leſs intimately mixed with the air in a mechanical way. This opinion is confirmed by Dr. White's experiments, who ſays: "the air over the river Ouze was conſtantly purer than that of the garden by 2 or 3 degrees." Philoſophical Tranſactions, vol. 68.—And in the ſame paper he obſerves, that the ſame happened with the air of the foſs when the marſhes were overflowed.

When I firſt engaged in theſe experiments it was my intention to perform them only on ſea air; but I ſoon found it neceſſary to repeat them on land air for the ſake of compariſon. The ſubject increaſed on my hands. The atmoſphere of marſhes preſented itſelf as worthy of ſerious inveſtigation. I therefore performed ſome experiments upon it; but proper length of time is neceſſary to their repetition; and for this reaſon I muſt omit them for the preſent, and merely relate thoſe I performed on the air of this city, its environs, and on the ocean.

I ſhall firſt proceed to the enquiry whether the atmoſphere differs in purity in different ſituations on land?

The opinion that the air is purer in the country and on the tops of mountains than it is in towns, is adopted by many; therefore in aſſerting the contrary we muſt prepare

prepare to meet with oppoſition, particularly from thoſe who have formed opinions from reaſoning alone, unſupported by experiments. In doubtful matters it is chiefly by the claſhing of opinion, that truth is finally diſcovered. This ſhall be both my conſolation and apology, if the reſult of my experiments ſhall be found to have induced me to differ from others. Nevertheleſs it will afford me conſiderable ſatisfaction to agree with thoſe whoſe deciſions reſt upon the ſame firm baſis. I ſhall therefore briefly mention the authors who agree with me in opinion.

Dr. Prieſtley concludes from his own experiments, that the difference of the air in different places, ſuch as is indicated by a mixture of nitrous air, is in general very inconſiderable. He mentions that the air of Harthill near Mancheſter and that of Wiltſhire were about the ſame.

The compilers of the Encyclopædia ſay; "that the general maſs remains upon all occaſions pretty much the ſame." And Scheele is much of the ſame opinion.

But the accurate Fontana ſpeaks with more confidence, and is more explicit. His aſſertions are founded upon the reſult of many experiments, and he is inclined to believe, that the ſlight variations mentioned by ſome philoſophers, are rather to be attributed "to the fallacious effects of uncertain methods" than to any real difference in the air itſelf. He found the air of Iſlington and London to ſuffer an equal diminution from the mixture with nitrous air. The air taken at different heights in London and Paris did not differ in purity. Air at the height of 313 and 202 feet in London, differed ſcarcely at all; and no difference was perceptible between the air of theſe heights and that of the ſtreet adjoining.

The more I reflect on this ſubject, the more I am inclined to adopt the following ſentiment of this laſt mentioned

tioned gentleman; viz. "The difference in the purity of the air at different times, is much greater than the difference between the air of the different places." Indeed moſt of the experiments related by Dr. Ingenhouſz alſo tend to confirm it. In general the difference in the air of different places at the ſame time was by no means conſiderable.

I ſhall now with more confidence relate the experiments I myſelf performed: but previous to this recital I ſhall give a brief account of the method I purſued.

It is neceſſary to remark, that every experiment I ſhall relate is the reſult of at leaſt two different trials.

Moſt authors who have engaged in this ſubject uſed eudiometers of a different conſtruction; I adopted the moſt ſimple as the beſt. Thoſe who deſire a particular deſcription of theſe inſtruments may be ſatisfied by referring to the Encyclopædia and different parts of Dr. Prieſtley's Treatiſe on Air. Mine is as follows;*

I had a glaſs tube about 14 inches in length, and in diameter nearly half an inch, provided with a graduated ſcale, made ſo as to ſlide upon the tube up or down as occaſion required. This ſcale was divided into one hundred equal parts.

My meaſure was a ſmall ſmelling bottle, containing ʒj. and gr. xvj. of clear pump water. The ſpace occupied in the tube by a bulk of air which this meaſured,

* The atmoſphere is proved by inconteſtable experiments to conſiſt in general of,

Oxygen gas 0.27
Azotic gas 0.72 and
Carbonic acid 0.01.

It is a fact well known to chemiſts, that nitious air will combine with oxygen gas and form a compound, viz. the nitric acid. As theſe two gaſes combine they aſſume a ſtate approaching nearer to that of a ſolid and conſequently occupy leſs ſpace than they did before their union. Upon this diminution of bulk depends our eſtimation of the purity of the air. The greater the contraction, the purer we ſuppoſe the air under trial.

could

could contain was equal to the hundred diviſions of the graduated ſcale.

My water trough on board of the ſhip was the common water bucket; on ſhore it was a common houſe bucket or tub.

The nitrous gas was prepared from diluted nitric acid and braſs filings.

At ſea I uſed ſea water in the trough; on land common pump water: for from different trials made by Dr. Ingenhouſz it is evident this circumſtance could not produce a variation in the reſult of the experiments.

My method of operating is as follows: After having introduced two meaſures of the air, whoſe purity I deſired to aſcertain, into the glaſs tube, I introduce one meaſure of nitrous gas; then, ſuffering the tube to remain undiſturbed for about a minute, I noted down how far the water aſcended without agitation; this is what I have called, upon mixture: I then agitated the tube three ſucceſſive times, after the manner of M. de Sauſſure, and noted how high the water roſe. In many inſtances I added a ſecond meaſure of nitrous gas, and thereby completely ſaturated the air under examination.

I was particularly cautious of avoiding miſtakes from hurry or inattention, and took ſome pains to guard againſt all the circumſtances Dr. Ingenhouſz mentions as liable to produce a variation in the reſult of experiments of this kind.

My firſt experiment on land air was performed Auguſt 2d, 1796. Two meaſures of air in the yard of my lodging, when mixed with one meaſure of nitrous air, left upon mixture 2.48 of a meaſure; and after ſhaking the tube 1.79. I then added another meaſure of nitrous air and 2.65 remained.

I then ſubmitted air to the teſt of the eudiometer which I had previouſly collected in different ſtreets of this city,

viz. in Water between Market and Arch Streets; in Spruce near Fourth Street; in Cheſnut near Fifth; and, in Market between Second and Third Streets. Each of theſe airs gave nearly the ſame reſult, and generally agreed with that of the air of the yard of my lodging: None of the experiments ſhew a difference of 0.02 of a meaſure.

Similar experiments I have ſince repeated and the reſult was the ſame.

Auguſt 3d. I collected air on the top of the hill whereupon Dr. Smith's Obſervatory ſtands at the Falls of Schuylkill, five miles from Philadelphia. In another phial I received air from above the middle of the road directly at the foot of the hill. And immediately on my return home I ſubmitted them and the air of the yard to experiment and found them to agree exactly as follows;

Upon mixture 2.48

After ſhaking the tube 1.78 and upon adding a ſecond meaſure of nitrous air 2.63 remained.

Auguſt 5th. I collected air from above two different marſhy ſituations immediately below the rope-walks to the ſouth of this city. It is of conſequence to remark that theſe marſhes are overflowed by the tide. Another phial I filled immediately before entering the city in Front Street. Theſe airs ſuffered an equal diminution from a mixture of nitrous gas, viz. 2.47 upon mixture; after ſhaking the tube 1.79; and after adding a ſecond meaſure of nitrous gas 2.64 remained.

The air near my lodging yielded upon mixture 2.49; after ſhaking the tube 1.78; and upon the addition of a ſecond meaſure of nitrous gas 2.62.

I performed ſome experiments on air collected in other ſituations about the city; but, finding the reſult ſo much the ſame as thoſe above related, I did not make any note of them, and remain perfectly ſatisfied that Fontana's aſſertion is well founded.

To theſe experiments I will ſubjoin thoſe I made on the ocean during a paſſage from Bourdeaux to Philadelphia. It appeared to me preferable to connect them in the form of a table, as thereby I ſhould avoid a needleſs repetition; and place before the reader a ſhort though accurate view of all the experiments at the ſame time.

The experiments I performed on the River Elk and Bay of Cheſapeak perfectly agree with each other; and the reſult was the ſame with thoſe performed on the 7th of July &c. as mentioned in the table. The wind blew from the North and the ſky was partially cloudy. They were performed in Auguſt laſt.

My experiments at ſea ſufficiently prove that the atmoſphere is conſiderably purer there than it is on land. Though there are ſome trifling differences in the reſults of ſeveral experiments, I have no reaſon to believe that they were owing to the different ſituation in point of latitude or longitude in which they were performed. I can form no ſyſtem reſpecting ſuch variations. Winds, temperature, rain, &c. do not ſeem to have produced them. As they did not obſerve any regularity in their occurrence, they may perhaps be attributed to certain unperceived errors which are unavoidably attendant on ſuch trials.

That the air at ſea ſhould appear nearly of the ſame purity in different latitudes does by no means aſtoniſh me; for if land air has certain matters mixed with it they are *perhaps* abſorbed; and if my ſuppoſition be true, that the influence of the Sun's rays on the water tends to encreaſe its purity, the opinion I entertain is not ſurpriſing. For when once purified, there are perhaps none, or few cauſes to render the air noxious after it is wafted from our towns and cities over a large body of water.

It occurred to me that probably the purity of the air at ſea varied at different periods of the day: to ſatisfy

myſelf on this point I made ſeveral trials on the 10th and 17th of June laſt. On the 10th I performed them at 9 o'clock A. M. at 12, and at 6 o'clock P. M. On the 17th at 9 A. M. and at 12 o'clock. The reſult of all the experiments of the ſame day was exactly ſimilar, at leaſt not perceptibly different.

Whether or not ſea air might be rendered more pure by agitation with water, appeared to me to be a queſtion worthy of being aſcertained. Particularly as ſome celebrated men reaſon that it has this effect, and muſt hence be looked upon as one of the greateſt reſources which we have for purifying the atmoſphere. Sir John Pringle and Dr. Ingenhouſz are of this opinion. But ſome of Dr. Prieſtley's experiments ſeem to contradict it; and ſo does the following aſſertion of the celebrated Scheele, who ſays; "L'air ne s'unit pas avec l'eau commune." Traité de l'air and du feu, p 51.

My experiments on this head are as follow: On the 26th and 28th of June, the 2d and 5th of July, equal bulks of ſea water and air were agitated for half an hour in my eudiometer tube; but I never diſcovered any abſorption to have taken place; neither was the air rendered purer, as was evident from a mixture with nitrous air.

It now appeared probable to me that ſea water was already ſaturated with all the gaſeous particles it could abſorb; and that freſh water when agitated with ſea air might diminiſh its bulk or alter its purity. In conſequence of this ſuppoſition, equal bulks of ſea air and freſh water were agitated as above; but it was not in the leaſt altered. Not entirely ſatisfied of the fallacy of my conjecture, I boiled ſea water a ſufficient time to purge it of the air it might contain. I then agitated ſea air with this boiled water as above mentioned and found no difference in reſult from the other experiments. Theſe reſults tend to confirm me in my belief that if ſea water

purifies the air, it is rather by adding a ſomewhat than by abſorbing any conſiderable quantity of effluvia floating therein. Though by this I do not mean to ſay that certain matters foreign to our atmoſphere do not float therein on land. If they exiſt, perhaps they may be ſubject to abſorption by water.

TABLE

TABLE OF EXPERIMENTS *performed on the Atmoſphere at Sea.* *By* ADAM SEYBERT, M. D.

Month.	Time of Day.	Ther.	Longitude.	N. Latitude.	Winds.	Eudiometer.	General State of the Weather, &c.
June. 5	12h	68°	33°47′	42°01′	SW. by S.	2.37 upon mixture, 1.68 after ſhaking the tube. 2.54 upon adding a ſecond meaſure of nitrous air.	High ſea: Sky clear.
10	12	ibid.	39 09	43 32	E.	2.37 upon mixture, 1.67 after ſhaking the tube.	For three days paſt had heavy gales, with a very high ſea: The winds were variable and the weather in general hazy and cloudy.
11	12	ibid.	40 35	43 20	SW. by S.	2.39 upon mixture, 1.70 after ſhaking the tube.	Sea moderate: Cloudy.
14	12	69	42 00	42 45	S. W.	2.40 upon mixture, 1.67 after ſhaking the tube.	Sea moderate: Cloudy.
16	12	68	43 05	43 26	S. W.	2.38 upon mixture, 1.70 after ſhaking the tube.	Sea moderate: Cloudy: Rained early this morning: The experiments were performed immediately after a heavy ſhower of rain.
17	12	ibid.	44 55	43 29	N. E.	2.38 upon mixture, 1.70 after ſhaking the tube, 2.54 upon adding a ſecond meaſure of nitrous air.	Sea perfectly calm: Partially cloudy.

Continuation

Continuation of TABLE OF EXPERIMENTS ON SEA AIR.

Month.	Time of Day.	Ther.	Longitude.	N. Latitude.	Winds.	Eudiometer.	General State of the Weather, &c.
June. 19	12h	69°	46°00′	42°40′	S. W.	2.40 upon mixture, 1 70 after ſhaking the tube.	Sea moderate: Sky clear.
22	12	ibid.	47 03	42 35	S. W.	2.39 upon mixture, 1.70 after ſhaking the tube.	Sea moderate: Cloudy.
23	12	67	49 05	41 59	N. E.	2.37 upon mixture, 1.67 after ſhaking the tube.	Rained during all laſt night, accompanied with thunder and lightning: Rain continued this morning: Sea moderate.
25	12	70	53 08	38 07	N. by E.	2.37 upon mixture, 1.67 after ſhaking the tube, 2.55 upon adding a ſecond meaſure of nitrous air.	Sea moderate: Partially cloudy.
26	12	ibid.	54 09	38 15	S. E.	2.37 upon mixture, 1.70 after ſhaking the tube.	Sea moderate: Partially cloudy.
28	12	68	55 11	39 00	N.	2.37 upon mixture, 1.69 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Laſt night heavy rain with thunder and lightning: Sea moderate: Sky clear.

Continuation

Continuation of TABLE OF EXPERIMENTS ON SEA AIR.

Month.	Time of Day.	Ther.	Longitude.	N. Latitude.	Winds.	Eudiometer.	General State of the Weather, &c.
July. 1	12	68°	56°45'	38°39'	N. W.	2.37 upon mixture, 1.69 after ſhaking the tube, 2.54 upon adding a ſecond meaſure of nitrous air.	Sea moderate: Sky clear: Heavy rain laſt night with thunder and lightning.
2	12	69	57 17	37 28	N. W	2.37 upon mixture, 1.70 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Sea calm: Sky clear.
3	12	70	57 38	37 05	S. W.	2.37 upon mixture, 1.70 after ſhaking the tube, 2.57 upon adding a ſecond meaſure of nitrous air.	Sea perfectly calm: Sky clear.
4	12	69	58 33	37 17	N. W.	2.37 upon mixture, 1.69 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Sea ſmooth: Sky clear.
5	12	70	59 30	37 16	N. W.	2.37 upon mixture, 1.67 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Sea ſmooth: Cloudy.

Continuation

Continuation of TABLE OF EXPERIMENTS ON SEA AIR.

Month.	Time of Day.	Ther.	Longitude.	N. Latitude.	Winds.	Eudiometer.	General State of the Weather, &c.
July. 6	12h	68°	60°33′	38°40′	W. N. W.	2.37 upon mixture, 1.67 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Sea ſmooth: Sky clear.
7	12	70	61 43	38 44	S. S. W.	2.37 upon mixture, 1.67 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Sea ſmooth: Sky clear.
13	12	69	72 25	39 11	S. W.	2.37 upon mixture, 1.67 after ſhaking the tube, 2.55 upon adding a ſecond meaſure of nitrous air.	At 3 o'clock A. M. had ſoundings in 33 fathoms water: Sea ſmooth: Cloudy: Thunder at a diſtance.
14	12	70	73 00	39 09	S. by E.	2.37 upon mixture, 1.69 after ſhaking the tube, 2.54 upon adding a ſecond meaſure of nitrous air.	Soundings in 20 fathoms water: Laſt night heavy rain with thunder and lightning: Sea ſmooth: Sky clear.
15	12	ibid.		39 00	S. W.	2 37 upon mixture, 1.70 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	About 5 leagues from the land: Sea ſmooth: Sky clear.

Continuation

Continuation of TABLE OF EXPERIMENTS ON SEA AIR.

Month.	Time of Day.	Ther.	Longitude.	N. Latitude.	Winds.	Eudiometer.	General State of the Weather, &c.
July. 16	12h	70°			S. W.	2.37 upon mixture, 1.67 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Cape-May in ſight: Land diſtant about 2 leagues: Sea ſmooth: Cloudy.
17	12	ibid.			S.	2.37 upon mixture, 1.70 after ſhaking the tube, 2.56 upon adding a ſecond meaſure of nitrous air.	Entering the capes: Sea moderate: Sky clear. At 6 o'clock P. M. off Bombay Hook: Experiments were performed and the reſult was the ſame as of thoſe at 12 o'clock.
18	11	ibid.			S. E.	2.37 upon mixture, 1.69 after ſhaking the tube, 2.55 upon adding a ſecond meaſure of nitrous air.	Oppoſite New-Caſtle: Partially cloudy: at 4 o'clock P. M. oppoſite Cheſter: Experiments were again performed, and the reſult was the ſame as of thoſe of the morning. A heavy thunder ſtorm ſucceeded in the evening.

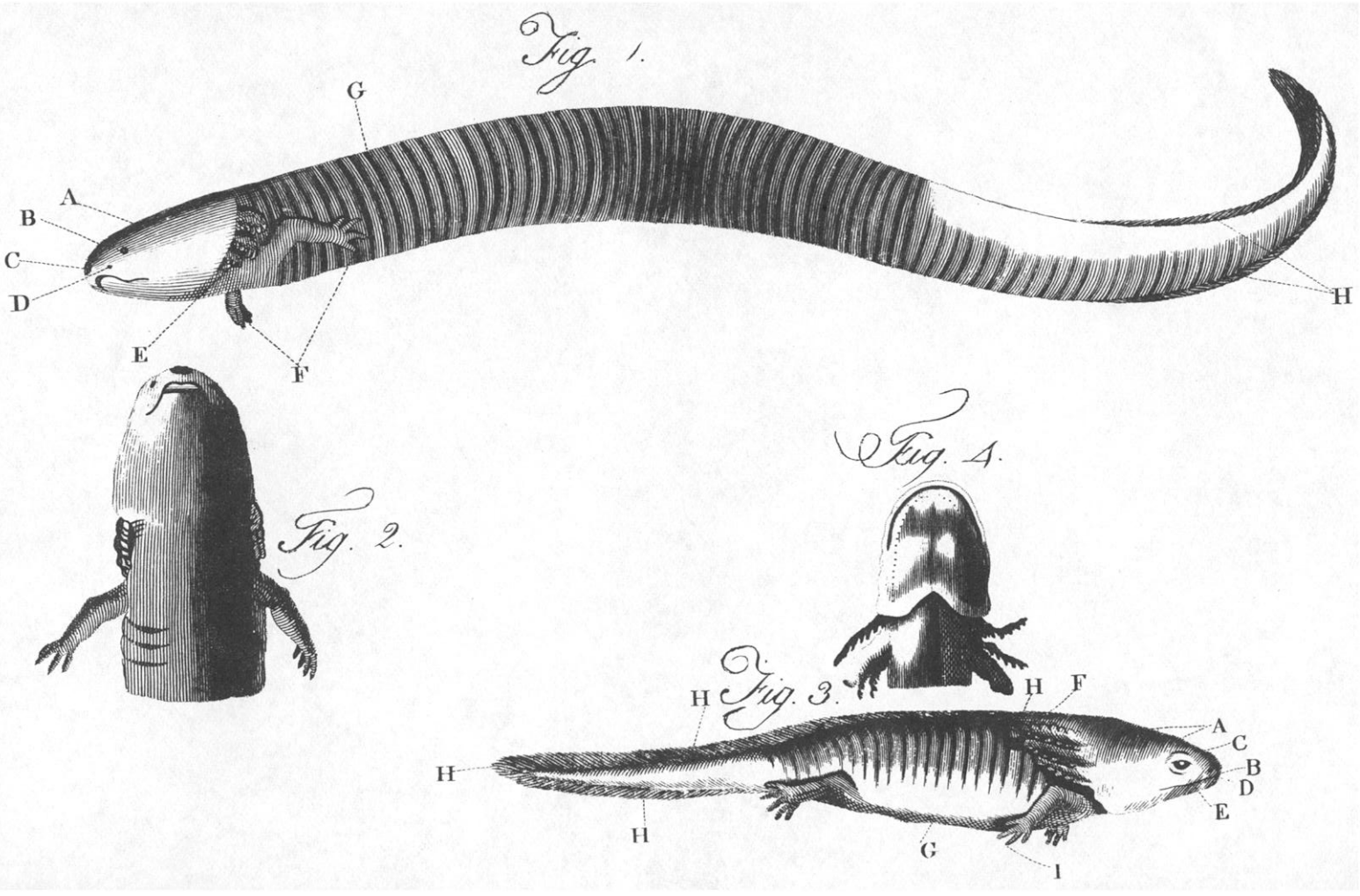
Fig. 1.
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